(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 981 037 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.02.2000 Bulletin 2000/08

(51) Int Cl.7: **G01C 15/00**

(21) Application number: **99306413.8**

(22) Date of filing: **13.08.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **14.08.1998 US 96646 P**
02.06.1999 US 324120

(71) Applicant: **THE STANLEY WORKS**
New Britain, CT 06053 (US)

(72) Inventors:
- **Bijawat, Viresh**
  North Haven, Connecticut 04673 (US)
- **Wakefield, David**
  North Brandford, Connecticut 04671 (US)

(74) Representative: **Laight, Martin Harvey**
W.H. Beck, Greener & Co.
7 Stone Buildings
Lincoln's Inn
London WC2A 3SZ (GB)

(54) Laser level

(57) A level (10) comprises a body (20), a body orientation detector (80, 82, 100), a laser beam source (130), a laser beam configuring lens (160), and a manually engageable lens switch (180). The body orientation indicator is carried by the body and constructed and arranged to indicate an orientation of the body. The laser beam source (130) is carried by the body and constructed and arranged to emit a laser beam from the body to a location on a surface remote from the body, the laser beam being directed at a predetermined orientation with respect to the body to interrelate the orientation of the body with respect to the location on the surface remote from the body. The laser beam configuring lens assembly (160) is carried by the body and movable between a first position and a second position with respect to the laser beam source. The laser beam configuring lens assembly splits the laser beam emitted by the laser beam source into a cross-hair beam configuration when the laser beam configuring lens is in the first position, and enables the beam to be transmitted as a point beam that projects a point of illumination onto the remote surface when the laser beam configuring lens assembly is in the second position. The manually-engageable lens switch (180) is carried by the body and coupled to the laser beam configuring lens assembly. The lens switch (180) is manually movable to move the laser beam configuring lens assembly (160) between the first and second positions thereof.

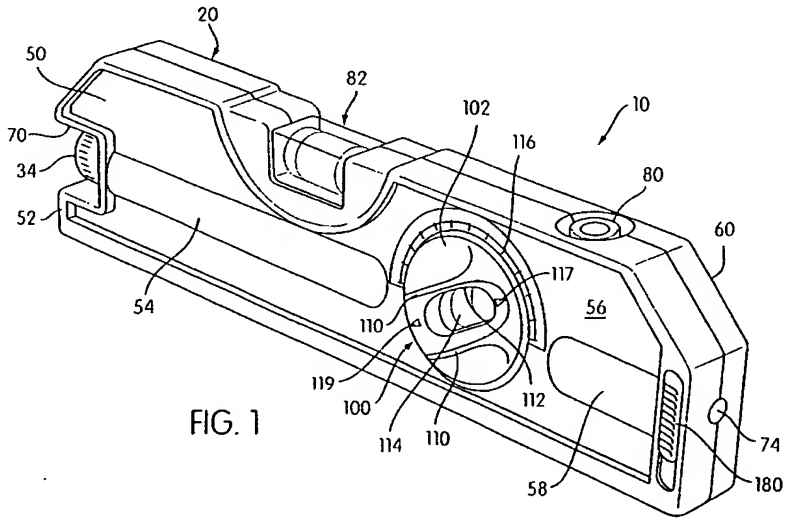

FIG. 1

EP 0 981 037 A1

Description

[0001] The present invention is related to a level having a laser beam source which projects a beam onto a surface remote from the level for interrelating the orientation of the level with respect to a location on the remote surface.

[0002] The prior art literature describes levels having a laser beam generator mounted therein for projecting a light beam to a surface remote from a reference surface on which the level is placed so as to interrelate the orientation or position of the reference surface with the remote surface. Levels with built-in lasers are also commercially available. A limitation of many such prior art levels with built-in lasers is that the laser emits a collimated beam that projects only a point of light onto the remote surface. A simple point of light projected onto a remote surface transfers relatively little information about the reference surface. For the most part, a point of light only transfers, or interrelates, the position of the reference surface onto the remote surface; it does not transfer, or interrelate, the orientation of the reference surface with respect to the remote surface. For example, a point of light will not provide a reference that indicates an orientation that is parallel or perpendicular with respect to the orientation of the reference surface engaged by the body of the level.

[0003] For example, U.S. Patent No. 3,897,637 describes a level which carries a laser internally thereof and which includes a beam splitter which splits the beam from the laser into two or more beams oriented transversely (e.g., orthogonally) to each other to project a point of light onto different remote surfaces oriented transversely to each other.

[0004] U.S. Patent No. 5,531,031 describes a level having a laser carried internally thereof in a rotatable mounting so that a laser beam can be emitted from the level at a user-selected, variable angle to project a point of light to a desired remote surface and at a selected angle with respect to the level.

[0005] While these levels may provide a point of light reference on a remote surface and may be capable of projecting that point of light at variable angles with respect to the level or to project multiple points of light simultaneously, they do not transfer the orientation of the level or the reference surface onto the remote surface.

[0006] It has been known that the orientation of the reference surface can be projected onto a remote surface by configuring the laser beam as a cross-hair beam with transversely intersecting lines of light being projected onto the remote surface. One line can, for example, be oriented so as to be parallel to the reference surface on which the level is resting and the intersecting line can be oriented so as to be perpendicular to the reference surface. The position of the level and reference surface on which the level rests is transferred by the point of intersection of the lines.

[0007] Although a laser beam configured as a cross-hair is desirable and advantageous in many instances, there are times when it is unnecessary and undesirable, and a simple point beam is preferable. For example, the more concentrated light of a point beam can be projected for greater distances in comparison with a split beam.

[0008] Heretofore, laser levels having cross-hair splitting capability have required disassembly in order to reconfigure the emitted laser beam as a point beam and vice versa. For example, to achieve a split beam from a point beam source, a laser lens housing assembly must be opened and a beam splitting lens inserted therein. To resume point beam projecting, the housing must be again opened and the beam-splitting lens removed.

[0009] Therefore, a need exists for providing a level having a laser projecting a beam, and overcoming or reducing these disadvantages.

[0010] According to the present invention there is provided a level comprising: a body having a body surface constructed and arranged to be engaged with a reference surface; a body orientation indicator carried by said body and constructed and arranged to indicate an orientation of said body, and hence an orientation of the reference surface when the body surface is engaged therewith; a laser beam source carried by said body and constructed and arranged to emit a laser beam from said body to a location on a surface remote from said body, the laser beam being directed at a predetermined orientation with respect to said body to interrelate the orientation of said body, and hence the reference surface engaged with the body surface, with respect to the location on the surface remote from said body; a laser beam configuring lens assembly carried by said body and movable between a first position and a second position with respect to said laser beam source, said laser beam configuring lens assembly being constructed and arranged to split the laser beam emitted by said laser beam source into a cross-hair beam configuration when said laser beam configuring lens assembly is in said first position, and to enable said laser beam to be transmitted as a point beam that projects a point of illumination onto a remote surface when said laser beam configuring lens assembly is in said second position; and a manually engageable lens switch carried by said body and coupled to said laser beam configuring lens assembly, said manually engageable lens switch being manually movable to move said laser beam configuring lens assembly between said first and second positions thereof.

[0011] It is an advantage of the invention that there may be provided not only a level having a laser projecting a beam that can be configured as a cross-hair beam, but also one that can also selectively project a point light beam if desired, without requiring disassembly of the laser lens assembly. The invention allows the provision of a level having a laser beam source which projects a selectively configurable beam onto a surface remote from the level. A level may be provided that includes a laser light source that can be easily converted between a point beam and a cross-hair beam.

[0012] There will now be set a number of preferred or optional features of the invention. Preferably said laser beam configuring lens is carried internally of said body. It may be arranged that said body is elongated and said body surface comprises an elongated flat surface, and said body orientation indicator comprises a liquid-containing vial constructed and arranged to indicate whether said flat surface is level in a direction of elongation. It may be arranged that said liquid-containing vial is constructed and arranged to indicate whether said flat surface is in a horizontally level orientation. It may also be arranged that said body orientation indicator comprises a liquid-containing vial fixed within a mounting structure that is coupled to said body and constructed and arranged to be manually rotated to a user-selected angle to indicate an orientation of said body with respect to said user-selected angle.

[0013] In one particularly preferred form, wherein said body is elongated and wherein said body surface comprises an elongated flat surface, said body orientation indicator comprises a first liquid-containing vial provided in a top portion of said body and constructed and arranged to indicate whether said flat surface is level in a direction of elongation, a second liquid-containing vial provided in a top portion of said body and constructed and arranged to indicate whether said flat surface is in a horizontally level orientation, and a third liquid-containing vial fixed within a mounting structure that is coupled to said body and constructed and arranged to be manually rotated to a user-selected angle to indicate an orientation of said body with respect to said user-selected angle.

[0014] In accordance with another feature of the invention, wherein said body is elongated and wherein said body surface comprises an elongated flat surface, it may be arranged that said body further includes a second body surface formed on a levelling flange extending laterally from a side surface and being elongated in the direction of elongation of said body, said levelling flange being arranged in parallel to said flat surface. In accordance with another feature, it may be arranged that said body has a threaded aperture formed therein constructed and arranged to permit said level to be secured to a tri-pod.

[0015] Conveniently said body is elongated and includes an elongated flat surface, and said laser beam source is constructed and arranged to emit the laser beam from said body along an axis that is parallel to the direction of elongation. Conveniently said laser beam configuring lens assembly is constructed and arranged to split the laser beam into a cross-hair light pattern having a first line arranged parallel to said flat surface and a second line intersecting said first line and arranged perpendicular to said flat surface, the point of intersection of said first and second lines being projected from said body along an axis that is parallel to the direction of elongation. Said laser beam configuring lens assembly may be constructed and arranged to split the laser beam into a cross-hair light pattern having intersecting lines bisecting an angle between said first and second lines.

[0016] In some preferred constructions, said laser beam source comprises a laser module carried internally of said body and constructed and arranged to generate and emit a laser beam, a power source including electrical batteries carried internally of said body and electrically connected to said laser module by a power circuit to provide electrical power to said laser module when said circuit is closed, and a manually operable power switch carried on said body and coupled with said circuit and constructed and arranged to permit a user to selectively close and open said circuit to thereby turn said laser module on and off.

[0017] An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, wherein like reference numerals designate corresponding parts in the various Figures, and in which:-

Figure 1 is a perspective view of a level having a laser beam source embodying the present invention;

Figure 2 is a front-elevation of the level;

Figure 3 is a back-elevation of the level;

Figure 4 is a top-plan view of the level;

Figure 5 is a bottom-plan view of the level;

Figure 6 is a right-side elevation of the level;

Fig. 7 is a partial cross-sectional view along line VII-VII in Fig. 4 illustrating a bull's eye level vial, a laser module, a moveable laser beam configuring lens assembly, and a bottom magnet of the level;

Fig. 8 is a cross-sectional view along the line VIII-VIII in Fig. 2 illustrating a bull's eye level vial, a laser module and module hanger, and a magnet of the level;

Fig. 9A is a cross-sectional view along the line IX-IX of Fig. 2 showing a laser beam configuring lens assembly in a first, laser beam-altering position;

Fig. 9B is a cross-sectional view along the line IX-IX of Fig. 2 showing the laser beam configuring lens assembly in a second, non-laser beam-altering position;

Fig. 10 is a back-elevation of the level with a back cover of the body of the level removed to expose the interior components of the level;

hanger 132 includes a lower transverse shelf 134, an upper transverse shelf 136, and a connecting sidewall 138. An opening 45 is provided in the inner block 24 below the circular vial mounting structure 36. A threaded fastener 140 extends through an aperture formed at the bottom of the opening 45 into the upper transverse shelf 136 of the hanger 132 to support the hanger 132 within the opening 48. A leaf-spring 146 is provided between the top of the upper transverse shelf 136 and the inner wall defining the opening 48. The laser module 130 is secured within the hanger 132 by means of a threaded fastener 142 extending through the connecting sidewall 138 into the module 130 with a leaf-spring 148 disposed between the sidewall 138 and the module 130. The orientation of the laser module 130 can be adjusted by turning one or both fasteners 140, 142. The laser module 130 is connected to the power-pack chamber 32 by wires 158 extending from the power-pack chamber 32 to the module 130. In the preferred embodiment, the end of the battery tube cover 34 provides a push-button switch for completing a circuit from the power-pack chamber 32 to the laser module 130 to energize the laser. The laser housed within the laser module 130 is preferably a conventional diode laser.

[0032] As shown primarily in Figs. 9A and 9B, a laser beam configuring lens assembly 160 is disposed in front of the laser module 130 between an end-wall 47 of the inner block 24 and an end-wall 75 defined by the front and back covers 50, 60. The laser beam configuring lens assembly 160 comprises a lens holder 162 in which is mounted a cross-hair lens 164. The lens holder 162 is slidably disposed in a slot defined between walls 41 and 47 of the inner block 24 and is maintained in a transversely centered position by dimples 166 which contact an outer wall 39 of the inner block 24 and a pair of flexible tangs 168 which bear against an interior wall of the front cover 50.

[0033] A manually-engageable lens switch 180 extends through a slot 55 formed in the front cover 50 and is connected to the laser beam configuring lens assembly 160 so as to permit the lens assembly 160 to be moved between a first position shown in Fig. 9A in which cross-hair lens 164 is disposed in front of laser aperture 46 and a second position shown in Fig. 9B in which the cross-hair lens 164 is moved away from laser aperture 46 and out of the path traveled by a beam emitted by the laser module 130. The cross-hair lens 164 is a beam-splitting lens constructed and arranged to split a laser beam into a cross-hair configuration. More particularly, as shown in Fig. 11B, when the laser beam configuring lens assembly is in the first position, the laser beam 131 enters the cross-hair lens 164 and is split into split-beam 133 so as to project a cross-hair pattern 202 onto a surface remote from the level 10. The cross-hair pattern 202 preferably includes a center point 208 and intersecting lines 204 and 206 which are preferably orthogonal (90°)with respect to each other. Moreover, line 204 is preferably perpendicular to the plane of surface 26 and line 206 would thus, be parallel to surface 26. It is also preferred for a second pair of intersecting lines 205, 207 to bisect each of the 90° angles between lines 204 and 206, so that a 45° spacing exists between adjacent lines of the cross-hair as shown.

[0034] In the context of the present invention, the term "line" in reference to the light patterns forming a cross-hair pattern may mean a continuous line of light, an aligned series of light points or dashes, or combinations of points, dashes, and or continuous lines.

[0035] On the other hand, when the laser beam configuring lens assembly 160 is moved to the second position shown in Fig. 11A, the laser beam 131 is transmitted undisturbed to project or illuminate a point 200 on a remote surface. The location of point 200 corresponds to the location of center point 208 of the cross-hair pattern 202.

[0036] Although no lens is provided through which the beam 131 passes when the assembly 160 is in the second position, a second transmitting lens, such as a plain transparent lens, a focusing lens, or a collimating lens may be included in the laser beam configuring lens assembly 160, so that the beam 131 passes through the second lens when the assembly 160 is in the second position.

[0037] The level 10 can be operated as follows: The level can be placed with either the body surface 26 or the flange 72 disposed on a reference surface, and the orientation of the body 20, and thereby the orientation of the reference surface on which the level is resting, can be determined or verified by one or more of the body orientation indicators 80, 82, and 100, as described above. Alternatively, the level 10 may be attached to a tri-pod at aperture 27, and a preferred orientation of the level 10, as indicted by one or more of the body orientation indicators 80,82, and 100, can be established. The laser aperture 74 is pointed at a surface remote from the level 10 and the laser module 130 is switched on to interrelate the position and orientation of the level 10 on the remote surface by projecting the position and orientation of the level 10 onto the surface. For example, the height of a reference surface above a floor can be projected onto a wall that is spaced from the surface by placing the level 10 on the surface and projecting the laser beam onto the wall. Parallel and perpendicular orientations with respect to the surface can be projected onto the wall by manually selecting a cross-hair configuration with switch 180 to project a cross-hair pattern 202 onto the wall.

[0038] Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications to the embodiments may be made without departing from the scope of the invention as described by the appended claims.

Claims

1. A level comprising:

   a body (20) having a body surface (26) constructed and arranged to be engaged with a reference surface;

   a body orientation indicator (80, 82, 100) carried by said body and constructed and arranged to indicate an orientation of said body, and hence an orientation of the reference surface when the body surface is engaged therewith;

   a laser beam source (130) carried by said body and constructed and arranged to emit a laser beam (131) from said body to a location on a surface remote from said body, the laser beam being directed at a predetermined orientation with respect to said body to interrelate the orientation of said body, and hence the reference surface engaged with the body surface, with respect to the location on the surface remote from said body;

   a laser beam configuring lens assembly (160) carried by said body (20) and movable between a first position and a second position with respect to said laser beam source (130), said laser beam configuring lens assembly (160) being constructed and arranged to split the laser beam (131) emitted by said laser beam source (130) into a cross-hair beam configuration (202) when said laser beam configuring lens assembly (160) is in said first position, and to enable said laser beam (131) to be transmitted as a point beam that projects a point (200) of illumination onto a remote surface when said laser beam configuring lens assembly is in said second position; and

   a manually engageable lens switch (180) carried by said body (20) and coupled to said laser beam configuring lens assembly (160), said manually engageable lens switch (180) being manually movable to move said laser beam configuring lens assembly (160) between said first and second positions thereof.

2. A level according to Claim 1, wherein said laser beam configuring lens assembly (160) is carried internally of said body (20).

3. A level according to Claim 1 or 2, wherein said body (20) is elongated and wherein said body surface comprises an elongated flat surface (26) and wherein said body orientation indicator comprises a liquid-containing vial constructed and arranged to indicate whether said flat surface (26) is level in a direction of elongation.

4. A level according to Claim 3, wherein said liquid-containing vial is constructed and arranged to indicate whether said flat surface is in a horizontally level orientation.

5. A level according to Claim 1, wherein said body orientation indicator comprises a liquid-containing vial (114) fixed within a mounting structure (102) that is coupled to said body (20) and constructed and arranged to be manually rotated to a user-selected angle to indicate an orientation of said body with respect to said user-selected angle.

6. A level according to Claim 1, wherein said body (20) is elongated and wherein said body surface comprises an elongated flat surface (26), and wherein said body orientation indicator comprises a first liquid-containing vial (82) provided in a top portion of said body (20) and constructed and arranged to indicate whether said flat surface (26) is level in a direction of elongation, a second liquid-containing vial (80) provided in a top portion of said body and constructed and arranged to indicate whether said tlat surface (26) is in a horizontally level orientation, and a third liquid-containing vial (114) fixed within a mounting structure (102) that is coupled to said body (20) and constructed and arranged to be manually rotated to a user-selected angle to indicate an orientation of said body with respect to said user-selected angle.

7. A level according to any preceding claim, wherein said body (20) is elongated and wherein said body surface comprises an elongated flat surface (26), and wherein said body further includes a second body surface formed on a levelling flange (72) extending laterally from a side surface and being elongated in the direction of elongation of said body (20), said levelling flange being arranged in parallel to said flat surface (26).

8. A level according to any preceding claim, wherein said body has a threaded aperture (27) formed therein constructed and arranged to permit said level to be secured to a tri-pod.

9. A level according to any preceding claim, wherein said body (20) is elongated and includes an elongated flat surface (26) and wherein said laser beam source (130) is constructed and arranged to emit the laser beam (131) from said body along an axis that is parallel to the direction of elongation.

10. A level according to Claim 9, wherein said laser beam configuring lens assembly (160) is construct-

ed and arranged to split the laser beam (131) into a cross-hair light pattern (202) having a first line (206) arranged parallel to said flat surface (26) and a second line (204) intersecting said first line (206) and arranged perpendicular to said flat surface (26), the point of intersection (208) of said first and second lines being projected from said body (20) along an axis that is parallel to the direction of elongation.

11. A level according to Claim 10, wherein said laser beam configuring lens assembly (160) is constructed and arranged to split the laser beam (131) into a cross-hair light pattern (202) having intersecting lines (205, 207) bisecting an angle between said first and second lines (206, 204).

12. A level according to any preceding claim, wherein said laser beam source comprises a laser module (130) carried internally of said body (20) and constructed and arranged to generate and emit a laser beam, a power source (32) including electrical batteries carried internally of said body and electrically connected to said laser module (130) by a power circuit to provide electrical power to said laser module when said circuit is closed, and a manually operable power switch (34) carried on said body and coupled with said circuit and constructed and arranged to permit a user to selectively close and open said circuit to thereby turn said laser module on and off.

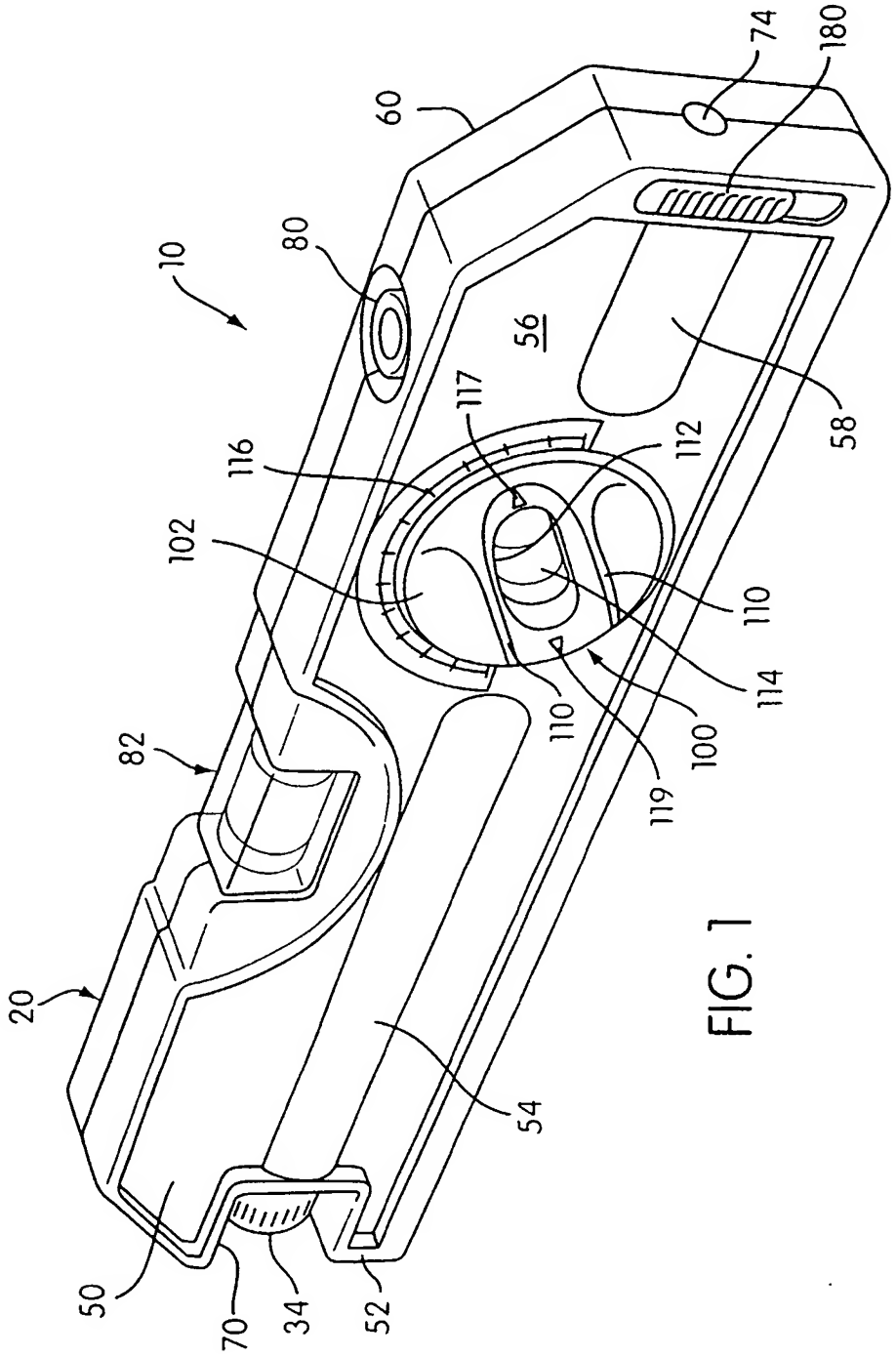
74
180
60
80
10
56
58
117
116
112
102
110
114
110
100
119
82
20
54
50
70
34
52

FIG. 1

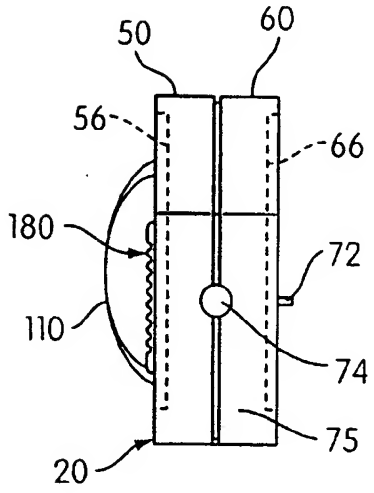
50
60
56
66
180
72
110
74
75
20

FIG. 6

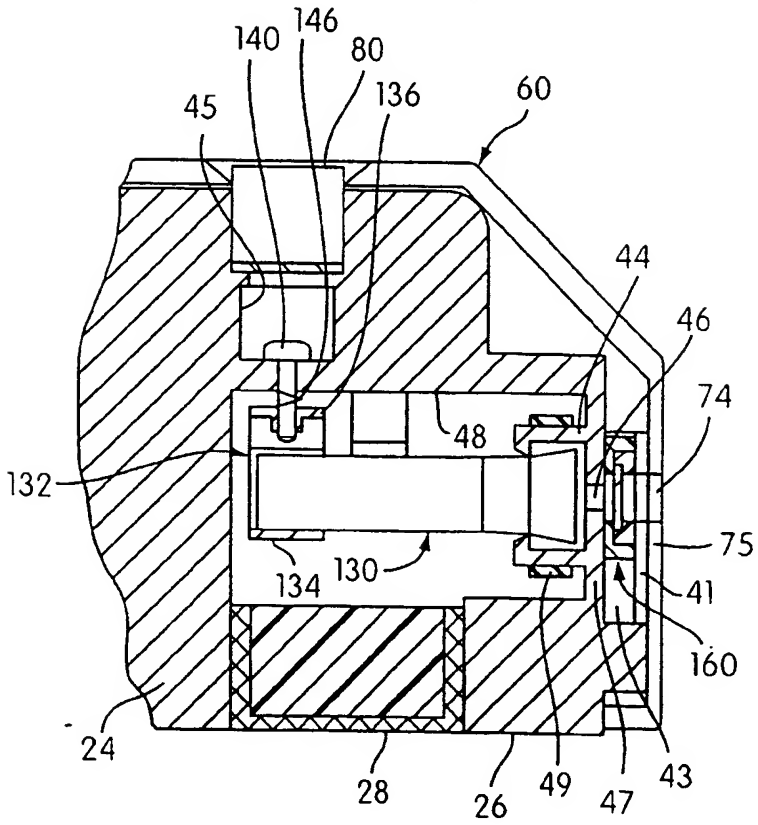
140
146
80
136
45
60
44
46
74
48
132
75
134
130
41
160
24
28
26
49
47
43

FIG. 7

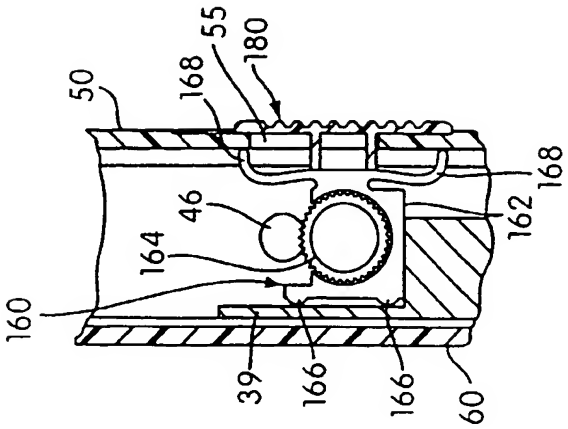

FIG. 9B

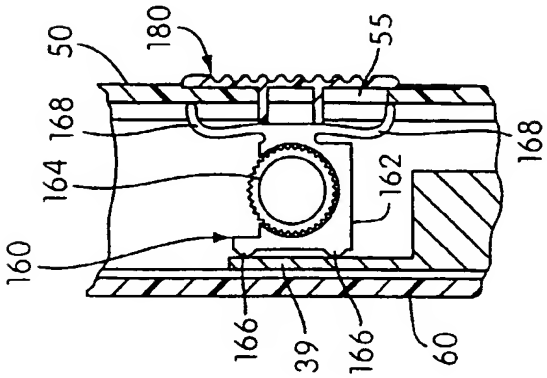

FIG. 9A

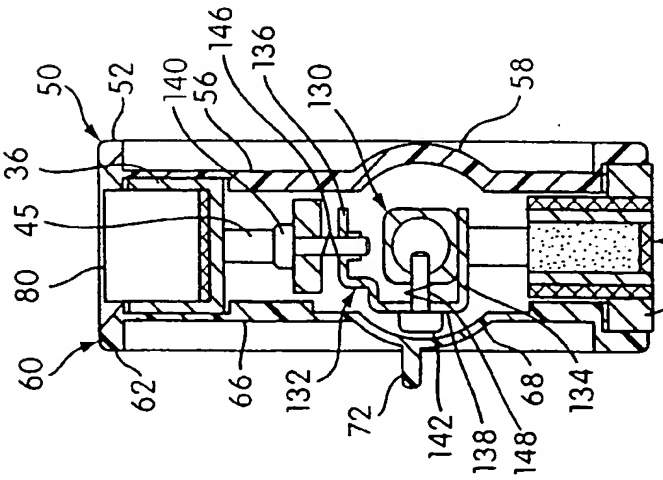

FIG. 8

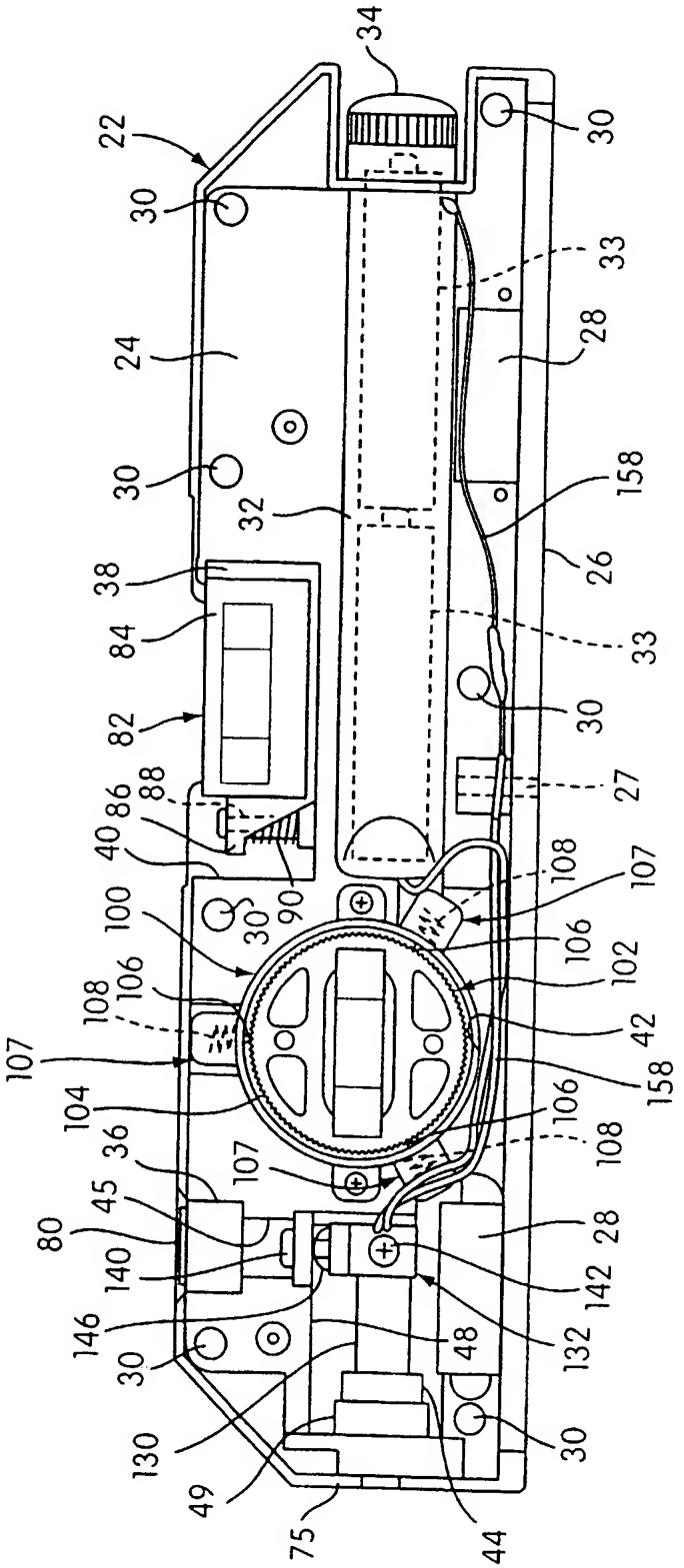
34
22
30
30
33
24
28
30
158
32
26
38
84
33
82
30
27
88
86
40
90
108
107
100
30
106
102
108
106
42
107
158
104
106
36
107
108
45
80
28
140
142
146
132
30
48
130
30
49
75
44

FIG. 10

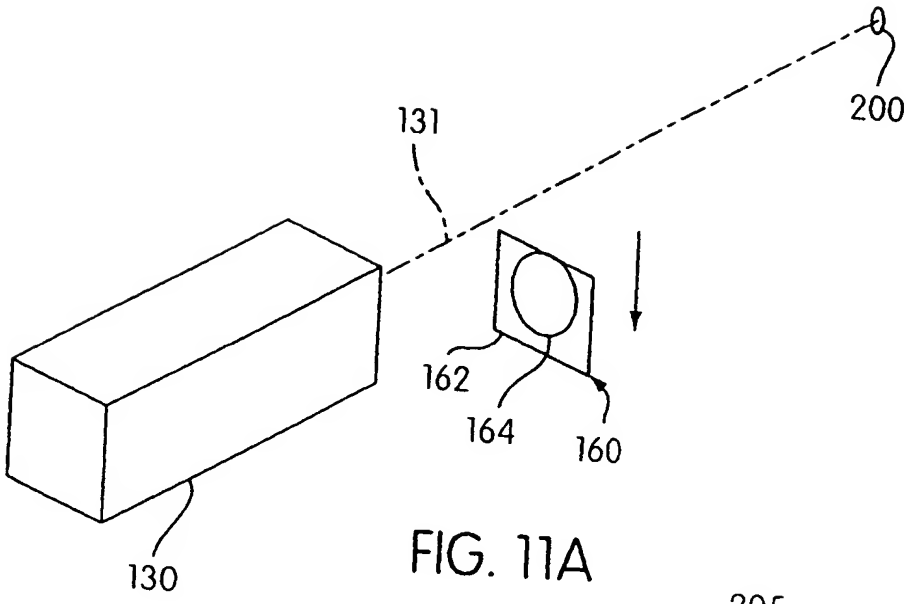

FIG. 11A

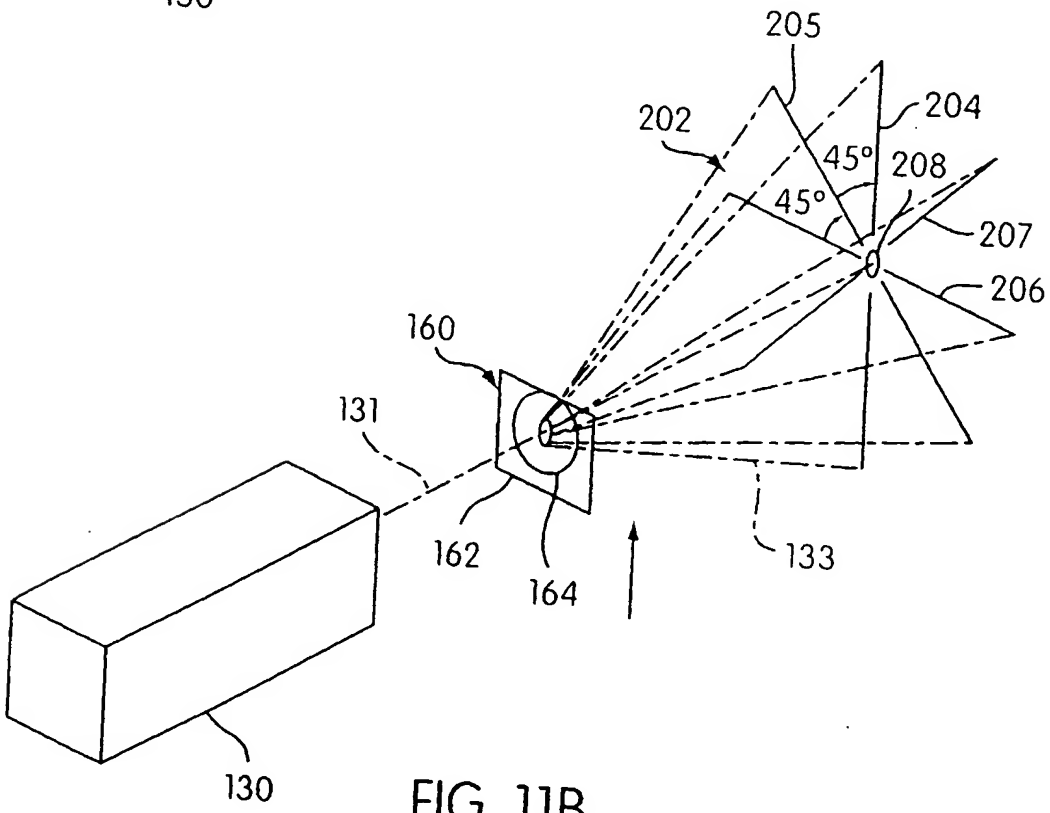

FIG. 11B

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 30 6413

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	US 5 748 306 A (LOUIS DANIEL P) 5 May 1998 (1998-05-05) * column 3, line 23 - column 5, line 16; figures *	1,2,12	G01C15/00
Y	DE 297 10 191 U (HO KO LIANG) 28 August 1997 (1997-08-28) * page 4, line 4 - line 19; figures *	1,2,12	
A	US 5 788 359 A (HALSEY KEITH D ET AL) 4 August 1998 (1998-08-04) * abstract *	1,2	
A	GB 2 319 084 A (DIBBEN CLIVE DAVID) 13 May 1998 (1998-05-13) * the whole document *	1,3-5,9, 12	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) G01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 November 1999	Hoekstra, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 30 6413

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-11-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5748306 A	05-05-1998	NONE	
DE 29710191 U	28-08-1997	NONE	
US 5788359 A	04-08-1998	NONE	
GB 2319084 A	13-05-1998	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82